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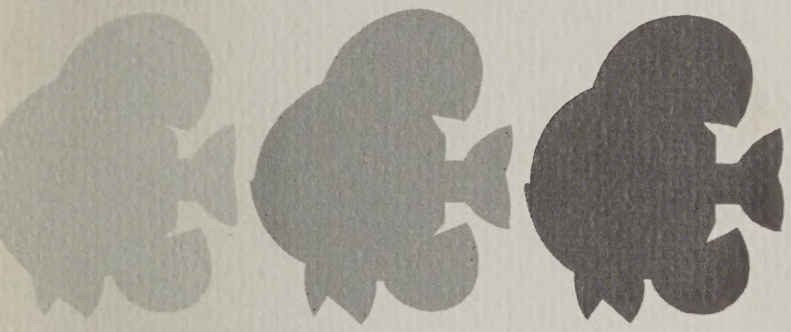

a study of rare fishes in the shawnee national forest, a cooperative project of the illinois natural history survey and the forest service, eastern region.

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THOSE ON THE BRINK OF DOOM:

A Study of Rare Fishes in the Shawnee National Forest.

A Cooperative Project of the Illinois Natural History Survey and the Forest Service, Eastern Region.

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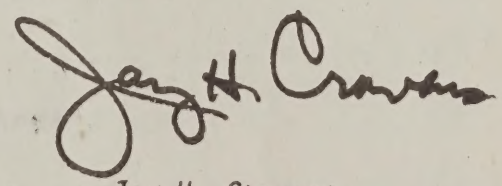
PROLOGUE

Beyond the obvious need for preservation of Endangered and Threatened Wildlife, we have concern for other species which unfortunately may be imminent candidates for the abyss of extinction. We need to evaluate these species more thoroughly and monitor their populational changes more closely. These animals may be on State endangered lists or may be regionally depleted. The Forest Service has classified animals of this status in an additional category: Unique Species.

Although presently in somewhat less dire straits than the designated Endangered and Threatened Species, these "Unique" animals may nevertheless be in need of our assistance. Often they occur in such low numbers and/or in such a restricted or specialized habitat that they may be extremely susceptible to elimination. The subsequent report concerns unique species of fishes on the Shawnee National Forest, and documents the Forest's concern for the preservation of these rare animals, as something beyond a hand-wringing display of apprehension. They have taken the bit in their teeth and spent of their limited wildlife funds to get expert evaluations of the status of these fishes. Further, they have taken the advice of these experts and have instituted recommended protection for these species.

The Shawnee National Forest has properly interpreted "wildlife" as a term encompassing all wild animals -- not game species alone. None of the fishes investigated in this contract study are of any significant interest to the angler. I appreciate the excellent piece of work the Illinois Natural History Survey has done on this study, and I am pleased with the Shawnee National Forest staff for assuming habitat responsibilities for all wildlife on the Forest.



Jay H. Cravens
Regional Forester
Eastern Region
Forest Service, U.S.D.A.

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PREFACE

by Ezra Ownse

In recent decades, there has been increasing indignation over the extirpation of wildlife species of this planet. Beyond this, the past decade has brought anxieties about species presently still short of extinction, yet in low and declining numbers -- those I have referred to in rhyme as tottering on the brink of doom. Today it is becoming more apparent that we must stop the slide of these declining species at an earlier stage. Protecting the last dozen or so individuals of a species may be too little, too late. It now appears -- at least in some animals -- that there is a numerical threshold below which recovery of the species is unlikely, or indeed impossible.

Most appeals for the protection of threatened animals have been emotional. They are entreaties aimed at public sensitivities rather than the public brain. Until recently, I had seen only two appeals for species preservation that had any defensible scientific elements in their plea. One of these concerns predator-prey relationships . The wolf pack and the cougar keep the prey herds healthy, since they remove mostly the halt and the lame. I fear, however, that despite its biological efficacy, this thesis falls short of conviction when one prey species is the deer hunter's target and the other the sheepman's livelihood. We need a still stronger scientific argument for preservation of these rare animals.

Similarly, the public hasn't responded *en masse* to the proposal that some contact with the natural world (with its plant and animal life a significant segment) is conducive to the physical and emotional health of mankind. Psychological studies by the Cornell University Medical School indicate that one fifth of the inhabitants of midtown Manhattan are emotionally or mentally unstable to the degree that they were indistinguishable from patients in a mental hospital. Further, an additional 60% showed some lesser degree of mental instability -- only 20% showed no symptoms of mental disease! The public has not related this to overcrowding in an artificial environment even though this type of aberrant behavior is abundantly documented in experimental studies of lower animals.

What we need, it seems to me, is a new, totally-confuting argument -- an unemotional appeal, a scientific law -- that indicates that a decrease in the number of species introduces a greater instability into the community. I have hopes that the Theory of Diversity will prove to be that biological law which shows irrefutably that the loss of any species makes this world a little poorer. Here would be a piece of knowledge which would

tell us why "this should not be"; as each species is eliminated, the prospect for environmental catastrophe increases, and this sphere becomes a lousier place to live.

Why won't this approach sell to the inquisitive mind? Why, as we pile up more scientific data, won't diversity prove to be the confuting evidence for the importance of preserving threatened species? It will, if (and a very large "if") we can translate diversity into terms that the general public can assimilate and understand. We need, perhaps, a Rachel Carson--that rare translator of scientific jargon into common terms--to explain diversity to the masses. When we can convincingly show that a community of 100,000 individuals of 12 species is a more unstable one than a community of 100,000 individuals of 20 species, we will have public support in our concern for threatened species. Then, and only then, can we forgo essentially emotional appeals (like my appended poem) for salvage of those species on the brink.

REQUIEM FOR THOSE WHO TOTTER ON THE BRINK OF DOOM

He stalks among the untrodden ways
Of Minnesota's primeval wood;
A beast whom there are few to praise,
And almost none call "good."

The timber wolf, that creature dread,
Is on our Threatened Species List;
As a species, now almost dead--
And most say he will not be missed.

But it is not right, this wish of Man,
The wolf into extinction to send.
It was not Evolution's immediate plan
That this animal's existence should end!

The same is true of the Indiana bat,
Which Homo seems destined to extirpate,
Unless its "evil" image we can
Somehow--someway--negate.

Who can make an osprey again
When the last one is gone from its native shore?
How will we re-create the prairie chicken when
The last prairie is no more?

What of the bird with the ivory bill,
Near elimination from this earth?
And when the jack pine woods are still,
What was that last Kirtland's warbler worth?

Will Man be able to synthesize
A replacement for the trumpeter swan?
When the wild lake's last shrill laughter dies,
Aren't we assured that the loon is gone?

An unnamed fish, recently discovered,
Has had its future compromised;
Man may already have wiped out the species
Before it was taxonomically recognized!

Others, too, in the same vein
Face extinction's all-final tomb;
The pupfish, key deer, sandhill crane
Totter on the brink of doom.

What gives us unquestioned right
To eliminate any one of these?
Are we so important in His sight
That He will condone such atrocities?

Why must Man demand dominion
Over his cohabitants of this sphere?
Why must he force on them his opinion
That they are no longer needed here?

Must he return them to the dust
From which he himself arose?
Wasn't our role a caretaker's <u>trust</u>,
Not the <u>dominion</u> we now impose?

The diversity law has been ignored.
It says this Earth-ark would better be
The more kinds of life we have aboard,
And the less likely catastrophe.

Must Man continue to snap each species' straw?
Is he too blind to see
That it is not <u>his</u>, but <u>Nature's</u> law:
The greatest good is in diversity!

-- Ezra Ownse

(By permission of the author)

A Study of Threatened and/or Unique Fishes Within the Boundaries of the Shawnee National Forest of Southern Illinois

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INTRODUCTION

Twenty-five species of Illinois fishes were classified as rare and/or endangered by Lopinot and Smith (1973, Rare and Endangered Fish of Illinois. Ill. Dept. Cons. Div. Fish. 53 p.). A study of three of these (*Elassoma zonatum*, *Lepomis symmetricus*, and *Chologaster agassizi*) and three other sporadically distributed and uncommon fishes (*Fundulus notti*, *Lepomis punctatus*, and *Etheostoma kennicotti*) was initiated to determine more accurately their status in Shawnee National Forest and to recommend measures to insure their continued success. This study was undertaken by four staff members of the Section of Faunistic Surveys of the Illinois Natural History Survey with partial funding provided by the U. S. Forest Service. The following is the report on the study by the Survey to the Forest Service.

To maximize results, the study was divided into three parts. Part 1 was a study of certain fishes in the LaRue-Pine Hills Ecological Area, a natural and nearly undisturbed swamp environment having populations of several rare fishes. For one of them (*Chologaster agassizi*) data were presented in a previous study conducted at Pine Hills (Norbert M. Welch Report on Spring Cavefish to U. S. Forest Service, 9 September 1973) and the species is included in this report only to add some additional information relative to the other species discussed.

Concurrent with the study of fishes in the LaRue-Pine Hills swamp was an active search for new localities within the boundaries of the National Forest Service for the threatened Illinois species. This involved visits to areas similar to those from which the species were already known. New localities were found for several of them and are appended to the species accounts with Part 1 of this report. However, no attempt was made to survey all aquatic habitats in Shawnee National Forest. Only those that appeared likely to have populations of the LaRue-Pine Hills species and Big Creek in Hardin County were studied in detail.

In the course of the search, another rare fish species was found that had not been anticipated. It is an undescribed and unnamed species of shiner, hereafter referred to as the lotus shiner. This fish, found in Wolf Lake in the early 1950's and rediscovered there in June of 1973, is to be described by Dr. R. M. Bailey of the University of Michigan when adequate study material becomes available.

Parts 2 and 3 were life-history studies designed to examine in detail the autecology of two of the unique species: *Lepomis symmetricus* and *Etheostoma kennicotti*. The study of *E. kennicotti* was begun prior to the initiation of funding by the Forest Service but was completed under that funding. The study of *L. symmetricus* was initiated at the same time as the study of the LaRue-Pine Hills fishes and is at present incomplete; however, a full year's data for *L. symmetricus* is briefly summarized herein.

The International Union for the Conservation of Nature (IUCN) has published a set of definitions incorporating information concerning distributions, habitats, ecological tolerances, and threatening factors to be used in the assessment of a species' survival status. The definitions relevant to this study are the following:

> Endangered: Actively threatened with extinction. Continued survival unlikely without the implementation of special protective measures.
>
> Rare: Not under immediate threat of extinction, but occurring in such small numbers and/or in such a restricted or specialized habitat that it could quickly disappear. Requires careful watching.

In light of these concepts and based on the results of all three parts of our investigation, we have formulated a series of recommendations for the management of the pertinent aquatic ecosystems in the Shawnee National Forest.

A Survey of Threatened and/or Unique Fishes in the Pine Hills Swamp and New Illinois Localities for Endangered Species

The Pine Hills swamp is a natural undisturbed system having a great diversity of plants and animals and is of vital importance as an area containing many species of vanishing native wildlife. The present study was a survey of the fish populations designed to determine the distributions and abundances of unique or threatened fish species throughout the swamp, including *Elassoma zonatum*, *Lepomis symmetricus*, *Lepomis punctatus*, *Fundulus notti*, and *Chologaster agassizi*. Attention is brought to these five species by an asterisk beside their names whenever they appear in subsequent tables.

Twelve trips, one per month, were made to the swamp during the period of 25 July 1973 to 28 June 1974. Eight permanent stations were used as sampling areas (Fig. 1). They included

all of the major aquatic habitats present in the Pine Hills swamp: shallow heavily vegetated swamps, open stretches of water, spring margins, and a beaver pond. Sampling at each location was done by minnow seine and/or funnel traps. For quantification of data (average number fish per square meter and other statistics), the size of the area sampled by minnow seine was estimated. Initially sunfishes more than 2 inches long were fin-clipped in an attempt to use the "mark-recapture" method of estimating population size. After several trips to the swamp, it was apparent that too few fish large enough to be marked had been encountered, and the marking procedure was abandoned. After being identified, measured, and recorded, all fish were returned to the water. Ecological notes were made at each station on each visit. In addition, oxygen and temperature readings were recorded. These measurements were taken both in the evening and morning to ascertain differences that time of day might make. Temperatures were rather constant and influenced by season and proximity of springs but not appreciably by sunlight and air temperature during a 24-hour period. Dissolved oxygen readings, however, differed sharply, except those stations moderated by spring flow and those in open-water stretches subject to wind action. Despite the extremely low, morning oxygen levels during the warm months for many of the typical swamp stations, no correlation between number of fish and amount of dissolved oxygen could be found. From February to June pH readings were taken; the values were rather consistent (5.3-8.5) throughout the swamp and the season and are therefore not discussed.

Twenty-seven fish species (Table 1) were collected at the eight stations. *Lepomis macrochirus*, *Pomoxis annularis*, and *Notemigonus crysoleucas* were especially abundant in the open-water habitats seined, and *Umbra limi*, *Fundulus notti*, *Gambusia affinis*, *Elassoma zonatum* were characteristic of the shallow, highly vegetated shoreline habitats throughout the swamp.

Trapping results were poor and biased. Only 30 individuals of five species were collected by trap, and over 90 percent of these were *Umbra limi* and *Aphredoderus sayanus* (Table 2).

Stations

Following are descriptions of sampling stations (Fig. 1), including oxygen and temperature readings, notes on plant life, and discussions of the fishes collected. Oxygen readings were lumped into two groups: November through March, and April through October. During the former time period, biological activity (respiration, decomposition, photosynthesis, etc.) was at its lowest; in the latter time period activity was at its highest. Tables 3 and 4 summarize the oxygen and

temperature data for each station. The winter (Dec.-Feb.) and summer (June-Sept.) temperature readings define the year's temperature range for each station.

In addition to listing the fishes collected at each station, the total number collected, number per square meter, relative density (number of a species collected/total number of fishes collected = percent), catch frequency (number of times the species was found at a station/total number of collections at that station), and an abundance index (relative density X catch frequency) are listed for each species of fish. The abundance index was computed to obtain a more complete comparative abundance measure which includes not only a measure of the number of a fish species caught (=RD), but also how consistently the species was collected (= catch frequency) at a station throughout the year.

Station Descriptions

Station 1 was an artificially constructed habitat, located under and along both sides of a railroad trestle. A moderate current from the swamp east of the railroad flowed under the trestle and produced a set of riffles at the west edge of the station. The average area sampled each month was approximately 40 square meters and the average depth ½ meter, ranging from 1/3 meter at the riffles to 1 meter directly under the railroad bridge. The oxygen readings for November through March ranged from 5.6 to 11.3 ppm and averaged 8.4 ppm, and for April through October ranged from 1.3 to 8.4 ppm and averaged 4.0 ppm. Water temperature averaged 6.7 °C for the winter readings and 24.2 °C for the summer readings. Station 1 contained very little vegetation; however, its outer perimeter was populated by *Cephalanthus occidentalis* and *Nuphar advena* and the surface often covered with duckweed. Twenty different fish species were collected at Station 1.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
Lepomis macrochirus	135	.296	57.0	.83	47.5
Gambusia affinis	37	.081	15.6	.67	10.5
**Fundulus notti*	11	.025	4.6	.33	1.5
Etheostoma gracile	8	.018	3.4	.42	1.4
**Elassoma zonatum*	5	.011	2.1	.33	0.7
Micropterus salmoides	4	.009	1.7	.33	0.6
Pomoxis annularis	5	.011	2.1	.25	0.5
**Lepomis punctatus*	6	.015	2.5	.17	0.4
Lepomis gulosus	4	.009	1.7	.25	0.4
Notemigonus crysoleucas	4	.009	1.7	.25	0.4
Aphredoderus sayanus	4	.009	1.7	.08	0.2
Dorosoma cepedianum	4	.009	1.7	.08	0.2

(Station 1 Species Continued.)

Pomoxis nigromaculatus	2	.004	0.8	.17	0.2
Etheostoma chlorosomum	2	.004	0.8	.08	0.1
Cyprinus carpio	1	.002	0.4	.08	0.05
Etheostoma asprigene	1	.002	0.4	.08	0.05
Lepomis cyanellus	1	.002	0.4	.08	0.05
Lepomis symmetricus	1	.002	0.4	.08	0.05
Noturus gyrinus	1	.002	0.4	.08	0.05
Umbra limi	1	.002	0.4	.08	0.05

Station 2 was a muck-bottomed area located on the swamp margin. The average area sampled was approximately 4 square meters, the average depth approximately 2/3 meter. The oxygen readings for November-March ranged from 1.6 ppm to 10.4 ppm and averaged 5.0 ppm, and for April-October ranged from 0.3 ppm to 8.1 ppm and averaged 2.7 ppm. Water temperatures averaged 7.0°C for the winter readings and 22.5°C for the summer readings. The station contained an abundance of *Ceratophyllum demersum* and its surface was covered by duckweed; the deep-side boundary opposite shore was densely populated by *Nuphar advena* and roots of *Cephalanthus*. Seven fish species were collected from the small area sampled.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
Umbra limi	124	2.702	70.9	.58	41.1
Elassoma zonatum	13	.283	7.4	.67	5.0
Gambusia affinis	17	.370	9.7	.25	2.4
Lepomis macrochirus	9	.196	5.1	.25	1.3
Aphredoderus sayanus	6	.131	3.4	.25	0.9
Esox americanum	3	.065	1.7	.17	0.3
Fundulus notti	3	.065	1.7	.17	0.3

Station 3 was swamp margin having very shallow water, and located near small spring emergences. The average area sampled was approximately 10 square meters, the average depth approximately ¼ meter. The oxygen readings for November-March ranged from 2.2 ppm to 9.9 ppm and averaged 7.0 ppm, and for April-October ranged from 0.3 ppm to 8.6 ppm and averaged 3.5 ppm. The water temperature averaged 7.1°C for the winter readings and 22.0°C for the summer readings. Station 3 was shaded by a thick tree cover of *Nyssa aquatica*. The dead tupelo leaves formed a thick leaf-litter bottom, and dead and decaying logs and branches were scattered throughout the station. Other aquatic vegetation consisted of a thin scattered layer of duckweed and an abundance of *Ceratophyllum demersum*. Twelve fish species were collected.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
Umbra limi	71	.603	47.3	.58	27.4
Gambusia affinis	21	.178	14.0	.33	4.6
Elassoma zonatum	16	.136	10.7	.33	3.5
Fundulus notti	17	.144	11.3	.25	2.8
Aphredoderus sayanus	7	.059	4.7	.33	1.6
Chologaster agassizi	5	.042	3.3	.25	0.8
Esox americanus	6	.051	4.0	.17	0.7
Centrarchus macropterus	2	.017	1.3	.17	0.2
Lepomis symmetricus	2	.017	1.3	.17	0.2
Amia calva	1	.008	0.7	.08	0.1
Lepomis gulosus	1	.008	0.7	.08	0.1
Lepomis punctatus	1	.008	0.7	.08	0.1

Station 4, a fairly deep area of quiet water with a muck bottom, was situated along a beaver dam at the swamp's edge. The average area sampled was approximately 6 square meters and the depth was about 1 meter. The oxygen readings for November-March ranged from 1.4 ppm to 10.9 ppm and averaged 6.2 ppm, and for April-October ranged from 0.2 ppm to 8.0 ppm and averaged 2.8 ppm. The water temperature averaged 6.6 °C for the winter readings and 21.8 °C for the summer readings. Partial shade was provided by *Acer rubrum* and *Nyssa aquatica*. The station contained scattered duckweed and an abundance of *Ceratophyllum demersum*. Eight species were collected from the small area.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
Elassoma zonatum	56	.752	31.5	0.83	26.1
Umbra limi	34	.456	19.1	0.58	11.1
Gambusia affinis	57	.765	32.0	0.33	10.6
Aphredoderus sayanus	17	.228	9.6	0.58	5.6
Fundulus notti	11	.148	6.2	0.58	3.6
Chologaster agassizi	1	.013	0.6	0.08	0.05
Esox americanus	1	.013	0.6	0.08	0.05
Centrarchus macropterus	1	.013	0.6	0.08	0.05

Station 5 was a densely vegetated area with a large spring located on its boundary. The average area sampled was approximately 11 square meters by 2/3 meters deep. The oxygen readings for November-March ranged from 3.8 ppm to 12.8 ppm, and averaged 8.1 ppm, and for April-October ranged from 4.2 ppm to 9.4 ppm, and averaged 4.6 ppm. The water temperature averaged 8.8°C for the winter readings and 19.7°C for the summer readings. The station had a muck bottom covered by a layer of tupelo leaves. The entire area was shaded. Aquatic plants present in the station were *Typha latifolia*, *Saururus cernuus*, *Ceratophyllum demersum*, and a very abundant species of *Spirogyra*. Fourteen fish species were collected.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
*Elassoma zonatum	45	.334	26.5	.75	19.9
*Fundulus notti	70	.520	41.2	.42	17.3
Umbra limi	12	.089	7.1	.25	1.8
*Chologaster agassizi	8	.059	4.7	.33	1.6
Esox americanus	6	.045	3.5	.33	1.2
Gambusia affinis	6	.045	3.5	.33	1.2
*Lepomis symmetricus	6	.045	3.5	.33	1.2
Lepomis gulosus	3	.022	1.8	.25	0.5
*Lepomis punctatus	3	.022	1.8	.17	0.3
Aphredoderus sayanus	4	.030	2.4	.08	0.2
Etheostoma gracile	3	.022	1.8	.08	0.1
Notemigonus crysoleucas	2	.015	1.2	.08	0.1
Lepomis macrochirus	1	.007	0.6	.08	0.05
Micropterus salmoides	1	.007	0.6	.08	0.05

Station 6 was a spring-fed pool adjacent to the bluff. Sampling was done by fish traps except in May and June, when 10-square meter seine hauls were made. The oxygen readings for November-March ranged from 7.5 ppm to 12.2 ppm and averaged 9.5 ppm, and for April-October ranged from 4.2 ppm to 9.4 ppm and averaged 7.2 ppm. The water temperature was also more constant than at the other stations, with the winter readings averaging 11.9°C and the summer readings 14.9°C. The vegetation wad dominated by a two-to three-inch layer of duckweed and an abundance of *Nasturtium officinale*. Four species were collected.

Species	No./m^2	RD
Aphredoderus sayanus	.450	39.1
Esox americanus	.350	30.5
*Fundulus notti	.300	26.1
Umbra limi	.050	4.4

Station 7 was a large, open-water area with little vegetation. The average area sampled was 121 square meters, the depth 1.5 meters. For July through September (the only months the station was sampled because of its depth), the oxygen averaged 5.9 ppm and the water temperature averaged 19.5°C. The shoreline vegetation was predominantly *Nelumbo lutea*. Fourteen fish species were collected.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
Lepomis macrochirus	127	.350	46.7	1.0	46.7
Pomoxis annularis	49	.135	18.0	1.0	18.0
Notemigonus crysoleucas	37	.102	13.6	1.0	13.6
Gambusia affinis	18	.050	6.6	1.0	6.6
Fundulus notatus	11	.030	4.0	0.67	3.1
Lepomis gulosus	6	.017	2.2	1.0	2.2
Fundulus olivaceus	8	.022	2.9	0.33	1.0

Centrarchus macropterus	4	.011	1.5	0.67	1.0
**Fundulus notti*	4	.011	1.5	0.67	1.0
**Elassoma zonatum*	2	.006	0.7	0.67	0.5
Micropterus salmoides	2	.006	0.7	0.33	0.2
Pomoxis nigromaculatus	2	.006	0.7	0.33	0.2
Etheostoma gracile	1	.003	0.4	0.33	0.1
**Lepomis punctatus*	1	.003	0.4	0.33	0.1

Station 8 was a densely vegetated pond-margin habitat with a partial tree cover. Its area was approximately 7.0 square meters, its depth 3/4 meter deep. The oxygen readings for November-March ranged from 4.4 ppm to 10.8 ppm and averaged 8.3 ppm, and for April-October ranged from 5.2 ppm to 8.5 ppm and averaged 6.5 ppm. The water temperature for the winter was 6.3°C and for the summer was 21.5°C. The station had scattered duckweed, *Ceratophyllum demersum*, and an abundance of *Typha latifolia* and *Nelumbo lutea*. Fourteen species of fishes were collected.

Species	Total No.	No./m^2	RD	Catch Freq.	Abund. Index
**Fundulus notti*	61	.989	35.5	0.78	27.7
Lepomis macrochirus	41	.665	23.8	0.78	18.6
**Lepomis symmetricus*	22	.357	12.8	0.89	11.4
Lepomis gulosus	13	.211	7.6	0.56	4.3
**Lepomis punctatus*	9	.146	5.2	0.44	2.3
**Elassoma zonatum*	10	.162	5.8	0.33	1.9
Aphredoderus sayanus	3	.049	1.7	0.22	0.4
Micropterus salmoides	3	.049	1.7	0.22	0.4
Esox americanus	2	.032	1.2	0.22	0.3
Pomoxis annularis	2	.032	1.2	0.22	0.3
Gambusia affinis	3	.049	1.7	0.11	0.2
Centrarchus macropterus	1	.016	0.6	0.11	0.1
Etheostoma gracile	1	.016	0.6	0.11	0.1
Fundulus notatus	1	.016	0.6	0.11	0.1

Species Accounts

The following accounts discuss total and Illinois distributions of the fish species studied, preferred habitats, ecological requirements, abundance, present status, and list the new Illinois localities discovered in the course of this investigation.

Fundulus notti (Agassiz).--The starhead topminnow ranges from southern Michigan west to Missouri and south to the Gulf Coast (Fig. 2). In Illinois, the subspecies, *F. n. dispar*, is sporadically distributed in northeastern Illinois, the middle Illinois River valley, and certain swamps in Union County (Fig. 2).

In the Pine Hills swamp, it was the third most abundant species and comprised more than 13 percent of the total sample. The species was most abundant at stations 5 and 8, Table 5, in shallow quiet waters abundantly vegetated with *Nelumbo lutea*, *Typha latifolia*, and *Ceratophyllum demersum*. It avoided open water.

Because of its tendency to school, the number per square meter at any given site and time is extremely variable but when all months are averaged for one site the number per square meter can be expressed with reasonable reliability. Thus, in optimal habitat such as station 8 its density averaged almost 1 individual per square meter but throughout the swamp the density was only about 1 fish per 6 ½ square meters. The population at Pine Hills is large, apparently stable, and in no way endangered at present. Gunning and Lewis (1955) found it to rank third in abundance and to comprise virtually the same percent of the total population of Pine Hills fishes in the early 1950's, Table 1.

New Illinois Localities: Wolf Lake, Wolf Lake, Union Co., 21 June 1973.

Elassoma zonatum Jordan.--The banded pygmy sunfish occurs from southern Illinois to the Gulf Coast and eastward to Florida (Fig. 3). In Illinois, its range has been decimated, but it still occurs in a few localities in Union, Pope, and Johnson counties (Fig. 3). In the Pine Hills swamp, it was found to be the fifth most abundant fish species, constituting almost 11 percent of the total sample. It was found at almost all stations sampled (Table 6) but reached its greatest abundance at station 4 in shaded, quiet waters containing *Ceratophyllum demersum*, Algae, and duckweed over a soft mud bottom. It was infrequent in open waters.

Casual observations by one of us (Smith) had suggested that the population level was rather low in the swamp, but fortunately such is not the case. The species was much more abundant than had been anticipated, reaching a density of 1 individual per 1 ½ square meters of water in optimal habitat but averaging only about 1 individual per 10 square meters throughout the swamp, Table 5. Gunning and Lewis (1955) also found it to be the fifth most abundant fish species and to constitute a little more than 7 percent of their total sample, Table 1. The population is large, stable, and in no way endangered.

New Illinois localities: Heron Pond, 1 mi. NW Forman, Johnson Co., 1 November 1971; Grantsburg Swamp, 1 ½ mi. E Grantsburg, Johnson Co., 19 May 1973; drainage canal, E of Dixon Springs, Pope Co., 5 May 1973, Wolf Lake, Wolf Lake, Union Co., 27 September 1973; Cache River bottom, 1 mi. E Ullin, Pulaski Co., 29 May 1974.

Lepomis punctatus (Cuvier and Valenciennes).--The spotted sunfish occurs from Illinois south to Texas and east to the Atlantic Coast of Florida and the Carolinas (Fig. 4). In Illinois, the subspecies *L. p. miniatus* is extremely sporadic and at present known only from the middle Illinois River valley and swamps in Union County (Fig. 4). In the Pine Hills swamp, it is distinctly uncommon, comprising only 1.6 percent of the total sample and represented by only 21 individuals. Over 70 percent of the specimens taken were at station 8, Table 6, in quiet waters vegetated with *Nelumbo lutea, Typha latifolia,* and *Ceratophyllum demersum*. A few individuals were taken at several other stations.

Although uncommon in the swamp, the species was nevertheless more common than had been anticipated, and the presence of young indicates recent reproduction. In optimal habitat, it may have a density of 1 individual per 6 square yards but throughout the swamp its density is negligent. Since it was only discovered in the swamp a few years ago, no data are available on its former abundance. The species is probably not endangered and its population levels may fluctuate from time to time. It is apparently more common in Wolf Lake, which during times of high water is connected with the Pine Hills swamp and may serve as a reservoir for recruitment.

New Illinois localities: Wolf Lake, Wolf Lake, Union Co., 21 June 1973.

Lepomis symmetricus Forbes.--The bantam sunfish was originally described from Pekin in central Illinois, but it is a southern fish and its present range is the lower Mississippi Embayment and east Texas (Fig. 5). In Illinois, it is known only from two localities in Union County (Fig. 5). In the Pine Hills swamp, it is uncommon, the 31 individuals taken making up only 2.3 percent of the total sample. More than 80 percent of the Individuals were taken at station 8, Table 6, but a few individuals were taken at several stations. The species prefers the quiet well-vegetated pools that also harbor the spotted sunfish and it avoids open water.

Gunning and Lewis (1955) found that the bantam sunfish made up five percent of their total sample, a figure probably not significantly different from the present. In optimal habitat, its density may approach 1 individual per 3 square meters, but throughout the entire swamp its density is very slight. It might be locally more abundant when individuals aggregate to spawn. The species is probably not endangered in the Pine Hills swamp, but it is less common there than in Wolf Lake, where we are studying its life history. Presence of young and various age-classes indicate reproduction in both Pine Hills and Wolf Lake.

New Illinois localities: Wolf Lake, Wolf Lake, Union Co., 21 June 1973 and subsequently.

Chologaster agassizi Putnam.--The spring cavefish was not a subject during this investigation because of the thorough study of its ecology conducted for the U. S. Forest Service by Norbert Welch in 1973. Remarks here about its ecology will therefore be confined to observations that supplement Welch's report. The fish may get into the swamp at any time when they are swept out from a spring. Casual observations by one of us (Smith) suggested that temperature was the critical factor and that during winter months individuals could survive water temperatures in the swamp but not during the summer. Welch correlated the number of individuals in springs with the volume output of the springs. It thus appears that temperature has nothing to do with the species occurrence in the swamp. Individuals are probably swept into the swamp during the very high winter flow of the springs and subsequently unable to find their way back to the spring mouths.

Gunning and Lewis's (1955) figure of 7.8 percent of their total sample was probably the result of selective sampling inasmuch as they mentioned that dipnetting, which is the most efficient method of capturing the cavefish, was one of their methods. The presence of the spring cavefish in the swamp is an accident that occurs only when a spring is adjacent to the swamp or has a high rate of flow.

Other Species.--Comparison of relative abundances of most of the species encountered in this survey and that of Gunning and Lewis in the early 1950's reveals relatively little change. Some differences are to be expected because of succession, year-to-year fluctuations in spawning success, and different sampling methods. Although most the species appear to have changed little in abundance, three show rather dramatic changes.

Gunning and Lewis found the pirate perch, *Aphredoderus sayanus*, to be the most common species and to comprise almost 36 percent of their total sample. We found it to rank eighth and to make up only 3 percent. We found the bluegill, *Lepomis macrochirus*, to be most common at 23 percent of the total; they found it to make up only 1 percent. The two fishes are conceivable competitors, and modifications of the swamp that create pondlike habitats (excavating fishing ponds, beaver ponds, destruction of aquatic vegetation, etc.) migh favor the bluegill, which is less dependent upon shallow, well-vegetated waters. The mosquitofish, *Gambusia affinis*, appeared to be more abundant during the recent study but may reflect only differences in sampling methods.

Table 1.--Fishes collected in LaRue-Pine Hills swamp from 25 July 1973 to 28 June 1974 and those reported from the swamp by Gunning and Lewis (1955, Ecology 36(4):554) along with relative abundances by percent. Appended are other species known to inhabit the swamp but not taken in the two surveys cited above.

Species	1973-1974	Gunning and Lewis (1955)
Lepomis macrochirus, blue gill	23.1	1.0
Umbra limi, central mudminnow	17.9	17.2
**Fundulus notti*, starhead topminnow	13.1	14.2
Gambusia affinis, mosquitofish	11.7	1.1
**Elassoma zonatum*, banded pygmy sunfish	10.8	7.1
Pomoxis annularis, white crappie	4.1	0
Notemigonus crysoleucas, golden shiner	3.2	0.1
Aphredoderus sayanus, pirate perch	3.0	35.7
**Lepomis symmetricus*, bantam sunfish	2.3	5.0
Lepomis gulosus, warmouth	2.0	1.0
**Lepomis punctatus*, spotted sunfish	1.6	0
Esox americanus, grass pickerel	1.3	2.1
**Chologaster agassizi*, spring cavefish	1.0	7.8
Etheostoma gracile, slough darter	1.0	1.0
Fundulus notatus, blackstripe topminnow	0.9	0
Micropterus salmoides, largemouth bass	0.7	1.4
Centrarchus macropterus, flier	0.6	1.8
Fundulus olivaceus, blackspotted topminnow	0.6	0
Dorosoma cepedianum, gizzard shad	0.3	0
Pomoxis nigromaculatus, black crappie	0.3	0.1
Amia calva, bowfin[1]	0.1	0.1
Lepomis cyanellus, green sunfish	0.1	0.1
Etheostoma chlorosomum, bluntnose darter	0.1	0
Etheostoma asprigene, mud darter	0.1	0
Cyprinus carpio, carp[1]	0.1	1.4
Noturus gyrinus, tadpole madtom	0.1	0
Ictalurus natalis, yellow bullhead	0.1	0.4
Erimyzon oblongus, creek chubsucker[2]	0	1.4
Lepomis humilis, orangespotted sunfish	0	0.1
Lepomis gibbosus, pumpkinseed[3]	0	0.1
Ictalurus nebulosus, brown bullhead	0	0.1
Lepisosteus oculatus, spotted gar[4]	0	0
Lepisosteus osseus, longnose gar[4]	0	0
Labidesthes sicculus, brook silverside[4]	0	0

1 Probably much more abundant than either survey indicates but difficult to sample by minnow seine.

2 Probably a misidentification of *Erimyzon sucetta* but specimens not available for confirmation. The lake chubsucker formerly occurred in a few scattered localities in southern Illinois.

3 Undoubtedly a misidentification. Most likely *Lepomis microlophus*.

4 Specimens in permanent collections of Illinois Natural History Survey.

Table 2--Fishes and their numbers taken throughout the year in standard minnow traps* at the stations.

Species	Station 2	Station 4	Station 6	Station 7
Aphredoderus sayanus	1	3	6	0
Umbra limi	14	1	2	0
Centrarchus macropterus	0	0	0	1
Gambusia affinis	0	0	1	0
Ictalurus natalis	0	0	1	0

*The unbaited, double-ended, funnel trap, 20 inches long with apertures of 1 ½ inches at either end, was generally impractical in the turbid water of the swamp. Besides the fish, several crayfishes and salamanders were trapped.

Table 3--Averaged* oxygen readings (ppm) throughout the year at the eight stations sampled.

Station	1	2	3	4	5	6	7	8
June-Sept.	4.0	2.4	3.8	0.3	3.6	7.0	5.9	5.9
Oct.-Nov.	4.4	2.1	1.8	3.1	5.9	8.8	-	6.4
Dec.-Feb.	8.8	4.7	7.5	6.2	7.7	10.1	-	8.6
Mar.-May	6.7	5.7	5.6	6.8	7.0	7.1	-	7.9

*Average of morning and evening readings on each trip and of the periods indicated in table. Although many of the individual readings in the June-September period appeared critically low, no correlation could be made between amount of dissolved oxygen and number of fish present.

Table 4--Averaged* water temperatures throughout the year at the eight stations sampled.

Station	1	2	3	4	5	6	7	8
June-Sept.	24.2	22.5	22.0	21.8	19.7	14.9	21.5	21.5
Oct.-Nov.	12.8	12.4	13.8	13.3	13.5	13.4	-	14.0
Dec.-Feb.	6.7	7.0	7.1	6.6	8.8	11.9	-	6.3
Mar.-May	18.1	17.3	17.7	15.4	16.9	14.4	-	18.4

*In winter, the swamp did not freeze even at 0 degrees C because of strong current and amount of spring flow. In summer, swamp temperatures were not excessively high because of shade and spring flow, but open water temperatures exceeded those in swamp proper.

Table 5--Averaged density (fish per square meter) of the four fishes studied in Pine Hills at the eight stations sampled throughout the year and average density throughout swamp.

Species	1	2	3	4	5	6	7	8	Ave.
Fundulus notti	.03	.065	.14	.15	.52	-	.01	.99	.141
Elassoma zonatum	.01	.28	.14	.75	.33	-	.006	.15	.116
Lepomis punctatus	.02	.0	.01	.0	.02	-	.003	.16	.017
Lepomis symmetricus	.002	.0	.02	.0	.05	-	.0	.36	.025

Table 6--Relative intraspecific abundance (number at each station/total number) of four fishes studied in the Pine Hills swamp at the eight stations sampled throughout the year.

Species	1	2	3	4	5	6	7	8
Fundulus notti	1.6	3.4	7.4	7.9	27.3	-	.5	52.0
Elassoma zonatum	0.6	16.8	8.4	45.0	19.8	-	.4	9.0
Lepomis punctatus	9.5	0.0	4.7	0.0	0.0	-	1.4	76.2
Lepomis symmetricus	0.5	0.0	4.6	0.0	11.5	-	0.0	82.9

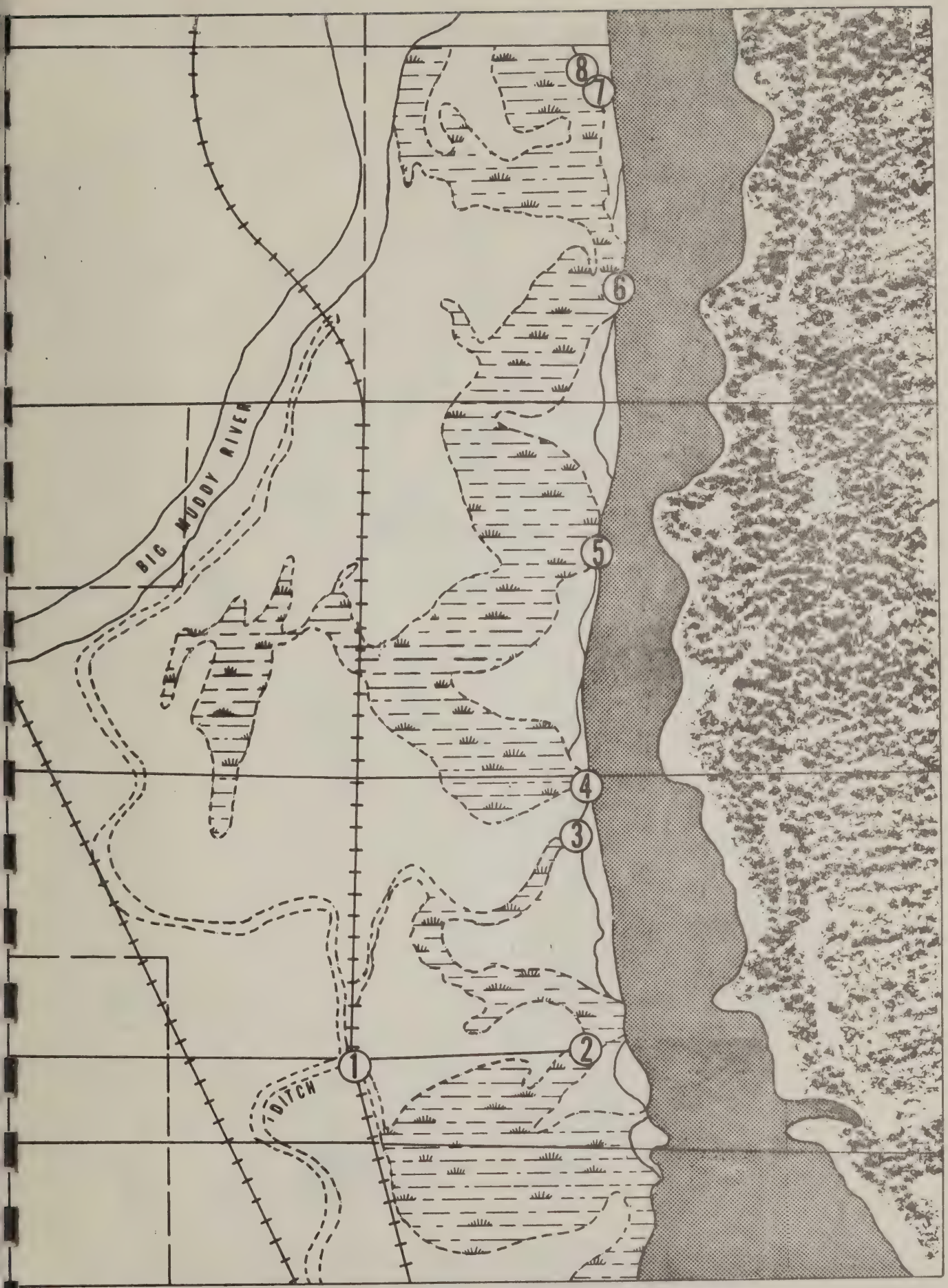


Fig.1 Collecting stations at Pine Hills Ecological Area

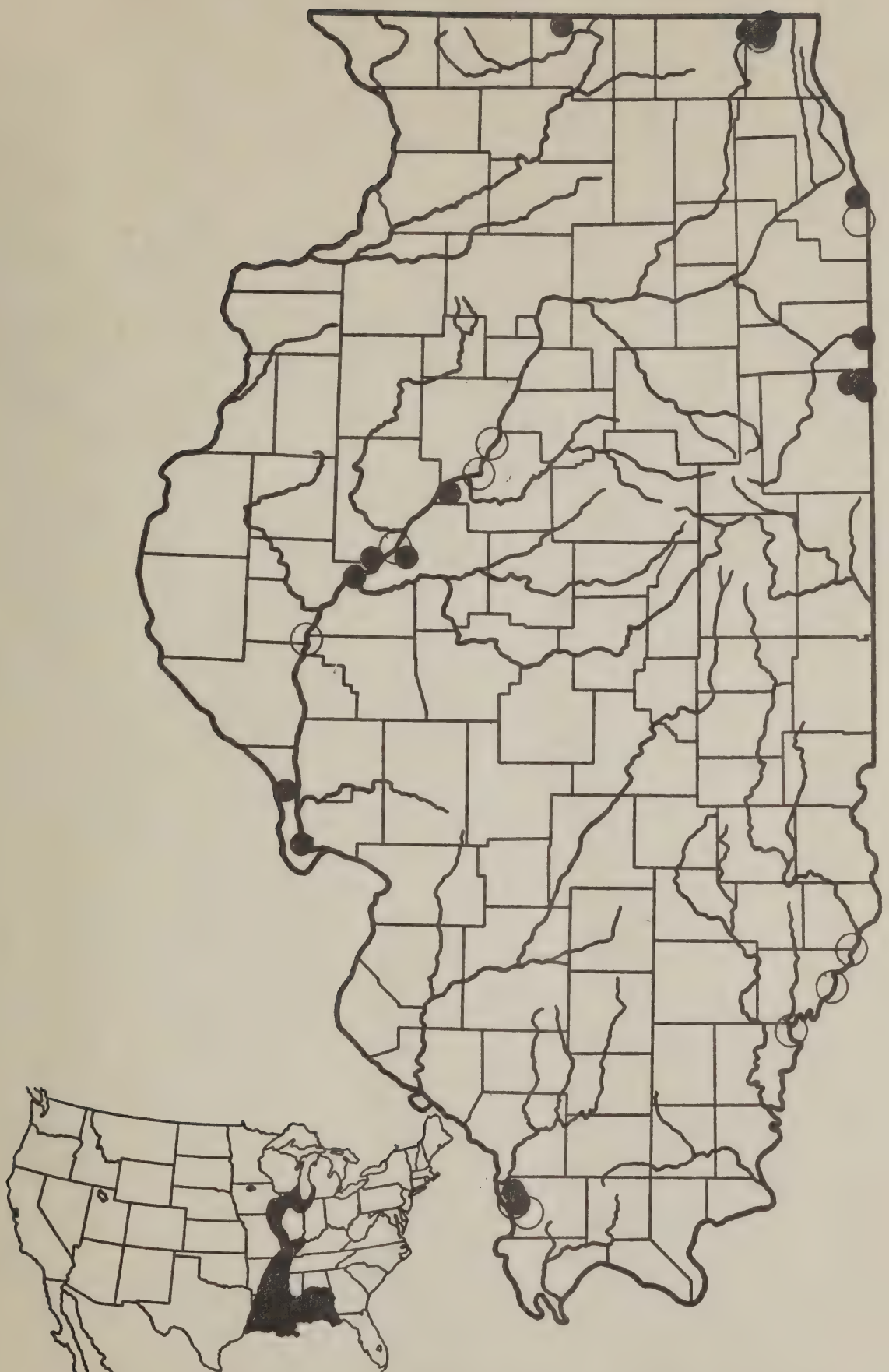


Fig. 2 - Distribution of Fundulus notti in Illinois and the total range (bottom left) of the species. Open circles are records from Fishes of Illinois (Forbes and Richardson 1908). Solid circles are recent records.

Fig. 3 - Distribution of Elassoma zonatum in Illinois and the total range (bottom left) of the species. Symbols as in Fig. 2.

Fig. 4 - Distribution of Lepomis punctatus in Illinois and the total range (bottom left) of the species. Symbols as in Fig. 2.

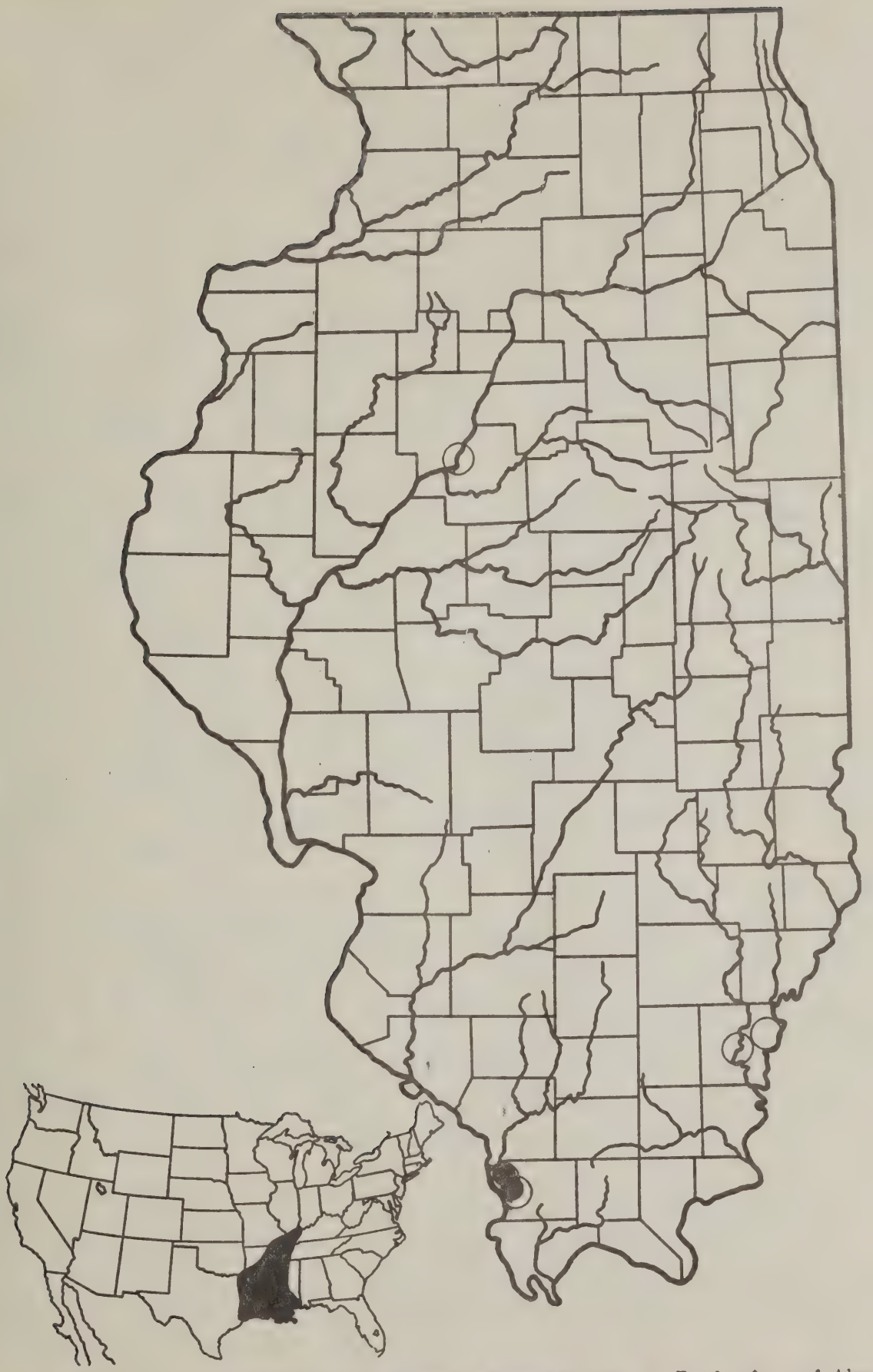


Fig. 5 - Distribution of Lepomis symmetricus in Illinois and the total range (bottom left) of the species. Symbols as in Fig. 2.

The Life History of the Bantam Sunfish, *Lepomis symmetricus*, in Wolf Lake

Wolf Lake is a large oxbow lake on the south edge of the LaRue-Pine Hills Ecological Area. The upper (northern) half of the lake, which adjoins the Ecological Area, has recently been acquired by the Forest Service from the Trojan Powder Company, but during our visits to the lake it was still Powder Company property. The lake is well oxygenated but the water is generally turbid. The perimeter of the lake is rich in aquatic vegetation, especially lotus, and cluttered with logs and submerged stumps. In the area selected for study of the bantam sunfish, two principal habitat types were present: the shallow, heavily vegetated, mud-bottomed shoreline and the deep, mud-bottomed area devoid of aquatic vegetation in the middle of the lake. The bantam sunfish, the smallest member of the genus *Lepomis*, was typically found in the shoreline vegetation.

Minnow-seine collections were made at one-month intervals throughout the year. The specimens were brought back to the laboratory, where they were measured, their sex and age determined, and their digestive tracts and bodies examined for parasites. Several from each series were also examined for stomach contents and gonad condition. Living specimens brought back to the laboratory in 1974 did not spawn in captivity.

Throughout its range, the species is rather localized and uncommon in quiet weedy lakes, oxbows, swamps, and sloughs. It reaches its greatest abundance in Louisiana. In Wolf Lake, it was never abundant but could usually be secured in its preferred habitat associated with a number of other sunfish species *Lepomis macrochirus*, *L. microlophus*, *L. gulosus*, *L. punctatus*, *L. cyanellus*, *Pomoxis annularis*, and *Micropterus salmoides*.)

No observations could be made on nest construction or other reproductive behavior of the species, but it was evident from examination of the gonads that males were sexually mature at one year of age and at a length of about 39 mm. Testes were enlarged during the spring months preceding spawning and young males lost the vertical barring typical of juveniles and became darkly pigmented. Females were sexually mature at one year of age at the same length as males. Female ova became large and orange during April and May. During other months the ova were small and white. Spawning presumably takes place during the last half of May and continues into June. The smallest young, taken in mid-June, was only 12 mm.

The largest specimen taken to date was 62.9 mm and 26 months old. The majority of the population consisted of one-year-old fish. The distinct black spot at the end of the second dorsal fin, which has been regarded as a sexual character, is instead an ontogenetic character that persists in both sexes up to 35 mm in length. Growth rates of males and females are not significantly different statistically.

A total of 154 stomachs were examined for food items. Specimens less than 30 mm fed primarily on microcrustaceans and dragonfly naiads; those between 31 and 40 mm fed on a variety of organisms but predominantly crustaceans; those more than 41 mm preferred gastropods, dragonflies, and dipterous larvae. In winter the diet of all size-classes was almost exclusively microcrustaceans but contained some aquatic insect immature stages, possibly the food most readily available.

Stomachs of 21 potential predators of several species failed to indicate predation on the bantam sunfish.

All age-classes of the bantam sunfish were infested by an unidentified endoparasite throughout the year except May and June. An adult acanthocephalan was taken in the stomach of a fish collected in April. No ectoparasites were found.

When data become available on spawning, all aspects of the life history and ecological requirements of this species will be presented in detail in a manuscript presently in preparation.

The Life History of the Stripetail Darter, *Etheostoma kennicotti*, in Big Creek

A study of the life history of *Etheostoma kennicotti* in Big Creek, Hardin County, Illinois, was completed in June 1974 and has been submitted for publication in the Illinois Natural History Survey Biological Notes series. The expected date of publication is May 1975 after which copies may be obtained by writing to the Chief of the Survey. Since the publication will soon be available, there is no reason for abstracting its contents for this report. The U. S. Forest Service is acknowledged for partial support of the field work.

The stripetail darter is neither rare or endangered in Big Creek, but its Illinois range is restricted to a few creeks in the Shawnee National Forest in the southeastern part of the state. A description of Big Creek is given under Recommendations.

BANDED PIGMY SUNFISH *Elassma zonatum*

SPOTTED SUNFISH *Lepomis punctatus*

BANTAM SUNFISH *Lepomis symmetricus*

Recommendations

General

Each of the three aquatic ecosystems discussed in this report has its own ecological characteristics, but certain general recommendations apply to all of them. The Forest Service should keep all three areas under close surveillance and prohibit or keep to a minimum:

1. Physical alteration (construction) that modified the habitats present.

2. Deforestation, stream impoundment, or other land-use practices (including the planting of Pine trees in lieu of native hardwoods) in adjacent areas that might affect the natural fluctuation of the water table.

3. The discharge of industrial, agricultural, and residential pollutants into these ecosystems.

4. The introduction of any exotic species or strains of plants and animals that could conceivably compete with the native biota.

5. The use of chemical poisons for censusing or other purposes and of all biocides, including herbicides.

6. Overdevelopment for public use because the principal value of these systems lies in their being maintained in a primitive state as refuges for native plants and animals.

7. Building fires.

8. Collecting of plants and animals by large supervised or unsupervised classes from schools because of damage to habitats by large groups of collectors.

In addition, the Forest Service should expand its educational programs and strive for the best public relations possible with residents of southern Illinois. The local public should be made to feel proud of the uniqueness of these areas and to have a better understanding of the need for their preservation and the restrictions on their use.

LaRue-Pine Hills Ecological Area

This spring-fed swamp surrounded by magnificent forest contains a unique assemblage of organisms. Despite its apparent ruggedness, its ecology is in a very delicate balance that could be upset by relatively minor modification of the area. The many springs that discharge into the swamp are probably the key to the swamp's uniqueness. The swamp is the source of Running Lake Ditch and one of the sources of Clear Creek. When the water table is high such as in the winter months, the large colume of flow flushes out the entire swamp, and throughout the year the springs moderate water temperature and supply oxygen to water depleted in oxygen by decomposition.

During the summer months, photosynthesis during the daylight hours also helps to replace dissolved oxygen in the swamp water. Should a massive kill of aquatic vegetation occur, the depletion of oxygen could be disastrous to aquatic life over a large area.

The canopy of forest trees and the dense duckweed cover provide shade that helps to protect much of the swamp from excessively high summer temperatures. The submerged and emerged aquatic vegetation provides habitats for a variety of animals that are adapted to the swamp environment.

Since maintenance of the swamp in its present condition is the most important consideration, the general recommendations cited above are imperative. Some specific recommendations follow:

1. Collecting should be permitted only if applicant has both a permit from the State of Illinois and the U. S. Forest Service as presently required.

2. Use of live minnows as bait should be prohibited in Winters Pond and elsewhere in the swamp.

3. The spotted sunfish, *Lepomis punctatus*, should be added to the list of species that may not be collected even by permit.

4. The tiles at spring mouths where spring cavefish are vulnerable to dipnetting should be capped.

5. Any improvement in the road between bluffs and swamp should try to avoid altering the rivulets that flow from the springs into the swamp. In fact, the road should be maintained but not improved at all.

6. Consideration should be given to some means of slowing speed of traffic on the road (warning signs, obstacles similar to "sleeping policemen," etc.)

7. If the Forest Service so desires, the starhead topminnow, *Fundulus notti*, and banded pygmy sunfish, *Elassoma zonatum*, could be removed from the list of species that may not be collected even by permit. However, the State of Illinois Fish Code would still prohibit taking of the pygmy sunfish.

8. Applications for special permits to collect aquatic organisms in the swamp should be reviewed by personnel of the Illinois Natural History Survey or other organizations that are acquainted with scientific research activities of other agencies and universities.

9. Construction of duck blinds from existing vegetation in the swamp should not be permitted.

10. Use of the Ecological Area for scientific research within reasonable limits by bonafide investigators and use by the public for nature photography, bird-watching, frog-listening, and hiking are probably legitimate, but the size of the group should be limited in some fashion to reduce impact on the habitats.

Wolf Lake

This lotus-margined ancient oxbow of the Mississippi River contains several of the species that occur in the Pine Hills swamp. In addition, it contains the still undescribed and unnamed lotus shiner and may harbor other rare organisms. The study of the biota of Wolf Lake to date has been minimal. The ecology of Wolf Lake is probably more stable than that of the Pine Hills swamp because the lake is less dependent upon spring flow. The most important recommendations revolve about keeping it in its present state and avoiding contamination by pollution and nonnative organisms.

1. If the Forest Service plans to conduct or contract for additional studies on the biota of the lake, it might consider constructing a new access road from Highway 3 to the lake edge and a small boat-launching ramp. This road and ramp should be restricted to authorized personnel only.

2. The presence of the lotus shiner in the lake should not be advertised lest the news entice collectors to the lake. After the species has been formally described, it should be placed on the list of species that may not be collected even by permit.

3. Regulation of collecting in Wolf Lake should be like that presently in use in the LaRue-Pine Hills Ecological Area.

4. When feasible, the Forest Service should attempt to acquire the entire lake and surrounding land.

5. The Trojan Powder Plant on the east bank of the lake should be inspected to discern if it is discharging toxic materials into the lake, and the Plant should be monitored for evidences of pollution discharge.

6. If public fishing is to be permitted, live minnows should be prohibited as bait.

7. An appeal should be made to the proper officials that the Missouri Pacific Railroad bed be improved so that future derailments are avoided.

Big Creek

Big Creek in Hardin County, Illinois, is a beautiful, rocky, spring-fed stream supporting populations of three rare crayfishes (one of which is endemic to Big Creek), uncommon fishes, and relict populations of northern fishes. These organisms inhabit Big Creek because of its unique characteristics, most notably the large influx of spring water. Rare species in other taxonomic groups (e.g. aquatic insects and annelids) are almost certainly present but as yet uninvestigated.

Among the species in Big Creek of special interest and importance are:

Orconectes species--an undescribed crayfish restricted in total distribution to Big Creek. A rather thorough investigation of other streams in southeastern Illinois and adjacent Kentucky have failed to produce any specimens of this large and colorful species. Common in downstream riffles, *Orconectes* species is replaced in upstream habitats in Big Creek by *Orconectes kentuckiensis*.

Orconectes kentuckiensis--a rare crayfish found in Illinois only in Big Creek and Peters Creek in Hardin County, and elsewhere only in a few streams in Crittenden and Union counties, Kentucky. This crayfish is common in upstream pools of Big Creek.

Cambarus laevis--a crayfish restricted in Illinois to a few spring-fed streams in Hardin, Johnson, and Pope counties. *C. laevis* is also found in Indiana, Ohio, Kentucky, and West Virginia.

Etheostoma kennicotti--the stripetail darter is restriced in Illinois to rocky streams in the Shawnee Hills.

Etheostoma squamiceps--the spottail darter is restricted in Illinois to rocky streams in the Shawnee Hills.

Ambloplites rupestris--the rock bass is restricted in southern Illinois to Big Creek, where a population is able to survive in the cool spring water.

Micropterus dolomieui--the smallmouth bass is restricted in southern Illinois to Big Creek. Like the rock bass, this important game fish persists in Big Creek as a result of the low water temperatures.

Hypentelium nigricans--a northern species, populations of the northern hogsucker are found in southern Illinois only in Big Creek and in Big Grand Pierre Creek.

Moxostoma duquesnei--the black redhorse is rare and sporadically distributed in Illinois. Big Creek probably contains the only large population in Illinois.

Cottus carolinae--the banded sculpin is rare and sporadically distributed in Illinois. A large population exists in Big Creek.

Lampetra lamottei--the brook lamprey is rare in Illinois and known from only six streams, one of which is Big Creek.

Other crayfishes and fishes present in Big Creek are:

Orconectes immunis
Cambarus diogenes
Esox americanus, grass pickerel
Campostoma anomalum, stoneroller
Notropis chrysocephalus, striped shiner
Notropis umbratilis, redfin shiner
Pimephales notatus, bluntnose minnow
Semotilus atromaculatus, creek chub
Erimyzon oblongus, creek chubsucker
Minytrema melanops, spotted sucker
Noturus miurus, brindled madtom
Ictalurus natalis, yellow bullhead
Fundulus olivaceus, blackspotted topminnow
Aphredoderus sayanus, pirate perch
Lepomis cyanellus, greensunfish
Lepomis macrochirus, bluegill
Lepomis megalotis, longear sunfish
Micropterus punctulatus, spotted bass
Etheostoma caeruleum, rainbow darter
Etheostoma nigrum, johnny darter
Percina caprodes, logperch

Several studies by the staff of the Section of Faunistic Surveys of INHS have been completed or are in progress on the Big Creek biota. Published is a life history of *Etheostoma squamiceps* (INHS Biological Notes No. 89); in press, the life history of *Etheostoma kennicotti*; and in progress are a description of *Orconectes kentuckiensis*, and *Cambarus laevis*.

Big Creek is at present under serious threat of overdevelopment. The stream banks are being cleared of trees, and if continued, will result in a raising of the water temperature and probable extirpation of those species in Big Creek dependent on the cool-water environment. The following steps are recommended.

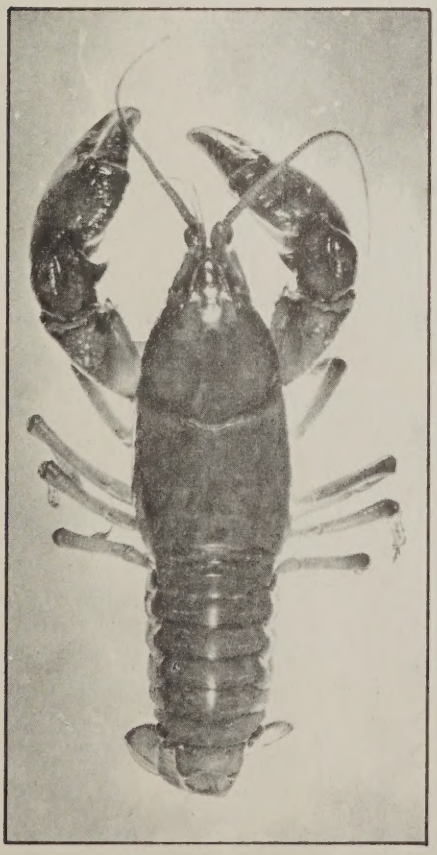
1. The Forest Service should purchase as much of the Big Creek watershed as possible.

2. Timber clearing along the watershed should be stopped.

3. Pine trees are known to use greater amounts of water than deciduous trees, thereby contributing to a lowering of the water table. The practice of planting pine trees in areas of the Big Creek watershed should not be continued.

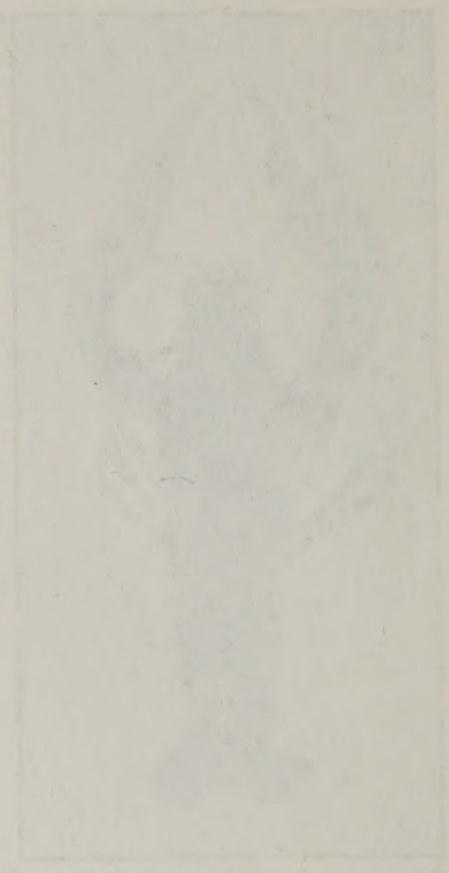
Orconectes kentuckiensis

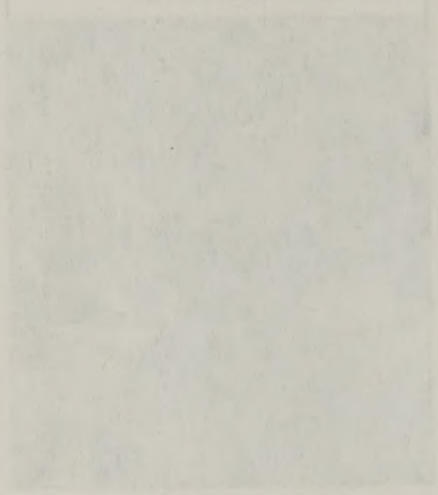
A typical slab pool in Big Creek, 2 miles east of Karbers Ridge, Hardin County. The habitat of *Etheostoma kennicotti*, *E. squamiceps*, and *Orconectes kentuckiensis*.

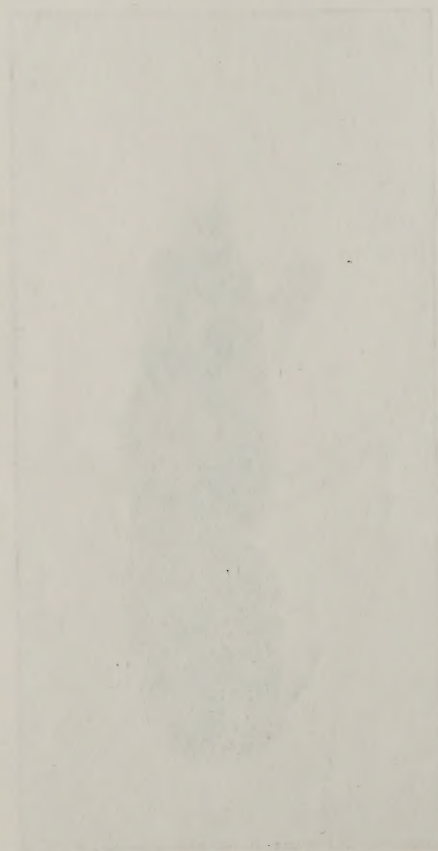


Cambarus laevis

Cambarellus shufeldtli







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